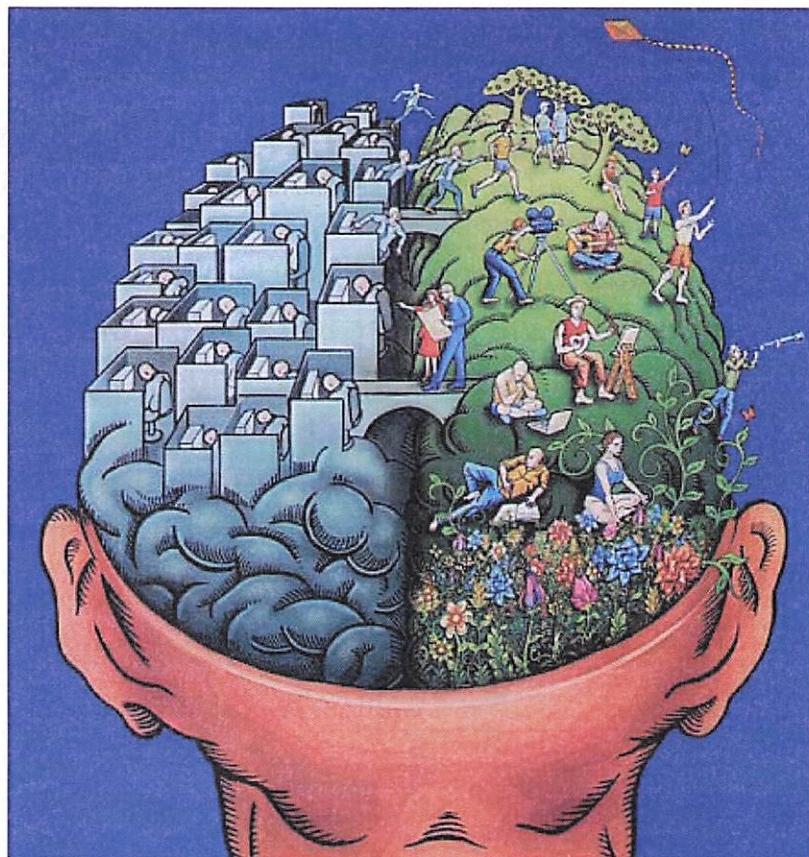


## How We Think and Learn

# About the Brain

Learning about the brain is key to understanding how learning occurs, and how to become a better learner.



The brain is a complex system that controls the functions of our entire body and is the control center for the nervous system. Every part of the brain is interconnected to other parts of the brain, and everything from hunger, to laughter, to deciding which movie to rent, to remembering your kindergarten teacher, is all tied up in the connections.

Knowing how the brain works can make you smarter. It can help you remember more and be able to better use your information. But, before examining how the brain learns and remembers new things, some understanding of its **physical structure** is necessary.

# The Structure of the Brain

The physical structure of the brain can be looked at from different perspectives: There are two hemispheres, four lobes, and three levels.

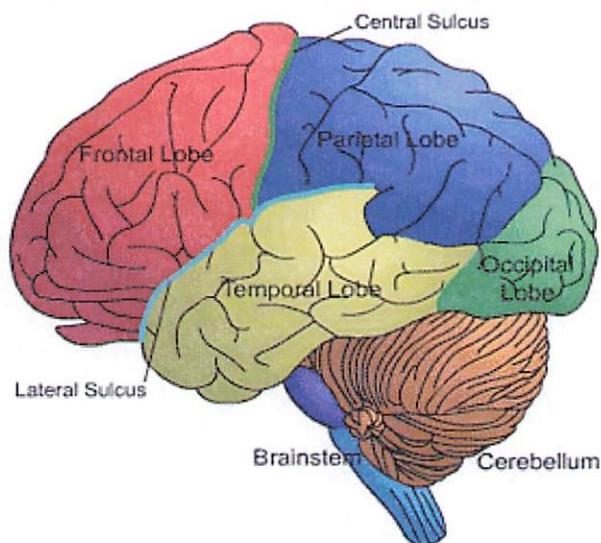


## Two Hemispheres

The brain can be examined from the outside, where it looks like it could be divided in half. Each half, or hemisphere is responsible for different brain activities and different kinds of learning. Not every person's hemispheres do exactly the same thing, but the **left hemisphere** generally controls language and logical thoughts, and moves the right side of the body.

The **right hemisphere** is most closely associated to visual processes and open-ended ideas. It also controls the left side of the body. At one time, the two hemispheres were thought to operate completely independently of one another. It is now understood that a thick band of nerves lets the two sides communicate information freely.

Figure AB-11: Lobes of the Brain



## Four Lobes

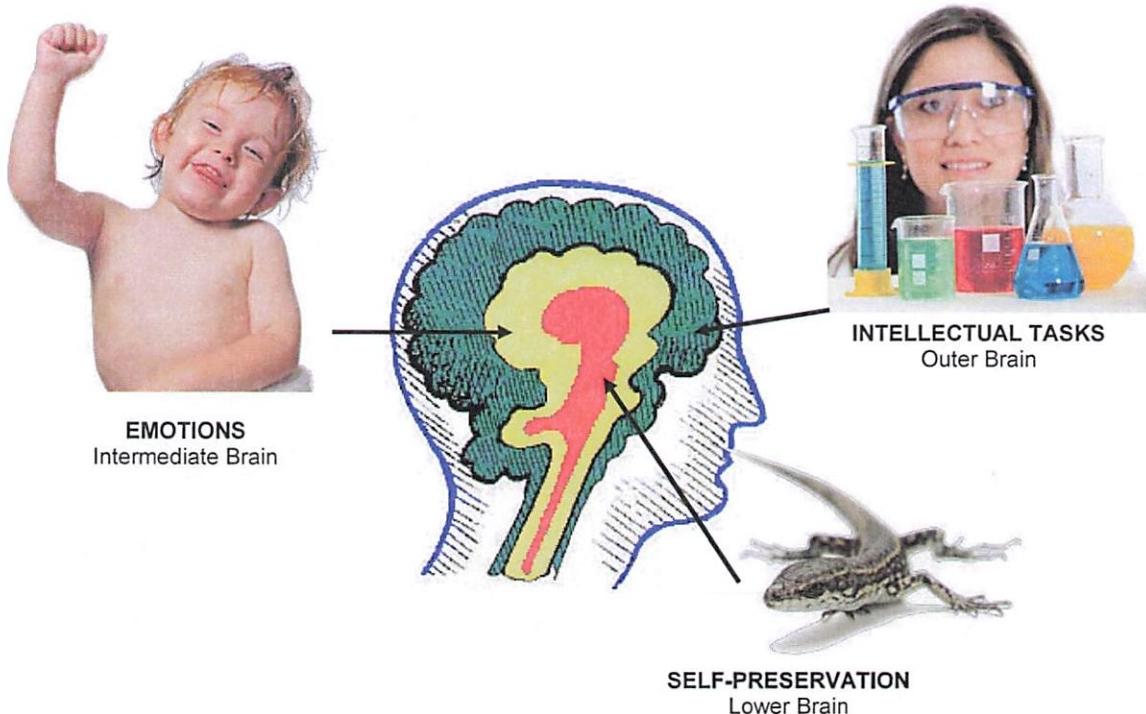
Another way to understand the brain is to see it as divided into four parts or lobes. From a side view, four different sections can be seen.

The **frontal lobe** is the front portion of the brain, behind the forehead. Creativity, problem solving, and planning are controlled by this part of the brain. On either side of the brain, behind your ears, are the **temporal lobes** which control language, hearing and memory. The **parietal lobe** is

at the top and back of the head. Sensory and language functions are performed here. The back of the brain, above the nape of the neck, is called the **occipital lobe**, where vision is controlled. If you feel along the back of your head, up from the neck, you will feel an indentation, then a bony ridge above it. This is the occipital ridge, and the occipital lobe is directly behind that part of your skull.

## Three Levels - The Triune Brain

The brain has been studied for centuries. Current discussions of brain research refer to the **triune brain**, meaning that it is made up of three (tri) distinct parts or levels. Looking at the brain from the inside out, these parts are the lower brain, the midbrain, and the outer brain. These three parts of the brain have also been referred to as the **reptilian brain**, the **primitive mammalian brain**, and the **modern mammalian brain**. These different levels show how the brain has evolved, and how the brain works in different species.



### The Lower Brain

This part of the brain controls all the basic life functions like heartbeat, blood circulation, breathing, and levels of alertness. There are 5 distinct parts to the lower brain, and each serves to ensure that the physical body is functioning. The reticular formation is one part of the lower brain, and this part is referred to as the **reptilian brain**, because it is found in all animals – reptiles, birds and mammals. This is where the 'fight or flight' instinct comes from.





## The Midbrain

This section of the brain is also made up of 5 interconnected sections. This is where hormone secretions are controlled, and emotions are processed. New learning gets transferred into long term memory in this area of the brain, and sensory information is processed here. There continues to be new scientific research discovering functions of parts of the midbrain. This section is referred to as the limbic system, or **primitive mammalian brain**, because this is the part that birds and mammals have (but not reptiles).

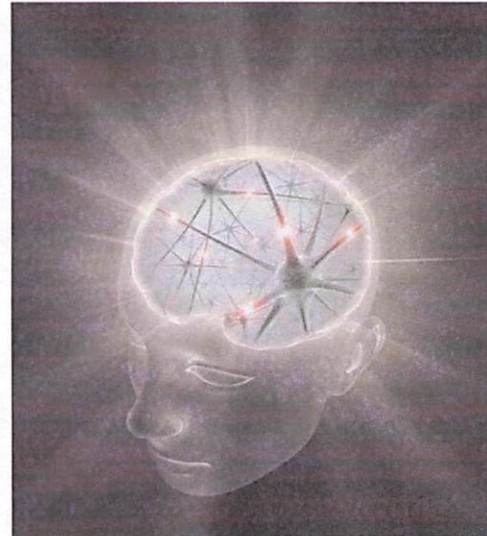


## The Outer Brain

This is also referred to as the **modern mammalian brain** because it is only found in highly evolved **primates** (including humans). This section is the grayish wrinkled outer layer of the brain, just inside the skull. The two hemispheres are connected here, and this is where our conscious decisions are made. This helps humans to control their instincts, which is part of the difference between human beings and other mammals.

## Putting it All Together

Each perspective of the physical make-up of the brain offers different information about how the brain functions, and how learning is affected. The physical parts of the brain are the actual sections that can be seen. This overview has made some connections to the parts of the brain and some of their functions or jobs. As the brain controls everything that happens within the body and processes all the sensory information about what goes on outside the body, the levels of detail that could be studied are extensive. Diagrams and images are useful tools to remember the different parts, so that functions can be remembered later on.



## About the Brain Vocabulary

<b>Physical structure</b>	The actual structure of the brain that you can see and touch.
<b>Left hemisphere</b>	A section of the brain that controls language and logical thoughts.
<b>Right hemisphere</b>	A section of the brain that is closely associated with visual information and creative processes.
<b>Frontal lobe</b>	One of four lobes: the frontal lobe is just behind the forehead and is closely involved with creativity, problem solving, and planning.
<b>Temporal lobes</b>	There are temporal lobes on each side of the brain behind the ears. The temporal lobes are involved with hearing, language, and memory.
<b>Parietal lobe</b>	The parietal lobe is at the top and back of the brain. It helps to perform sensory and language functions.
<b>Occipital lobe</b>	The occipital lobe is in the back of the brain and is where vision is controlled.
<b>Triune brain</b>	Triune brain refers to the brain as having three (tri) levels related to how the brain developed over time. The most primitive part of the brain is in the center and the more modern part is on the outside.
<b>Reptilian brain</b>	The reptilian brain is the oldest part of the human brain. It has much in common with other reptiles, birds and mammals. It controls the physical functioning of the body, quick responses, and the "fight or flight" instinct.
<b>Primitive mammalian brain</b>	The primitive mammalian brain has much in common with birds and other mammals, but not reptiles. It is where emotions and hormones are processed and where long-term memory resides.
<b>Modern mammalian brain</b>	The modern mammalian brain is found only in highly functioning mammals like humans and apes. It is where conscious decisions are made.
<b>Primate</b>	A biological designation for a group of animals that includes humans, monkeys, apes and similar animals that have forward-facing eyes, binocular vision, and opposing thumbs.

## About the Brain

# Vocabulary Match

Write each of the following words next to its matching definition.

• Physical structure	• Temporal lobes	• Reptilian brain
• Left hemisphere	• Parietal lobe	• Primitive mammalian brain
• Right hemisphere	• Occipital lobe	• Modern mammalian brain
• Frontal lobe	• Triune brain	• Primate

A section of the brain that controls language and logical thoughts.

One of four lobes: the frontal lobe is just behind the forehead and is closely involved with creativity, problem solving, and planning.

The parietal lobe is at the top and back of the brain. It helps to perform sensory and language functions.

The reptilian brain is the oldest part of the human brain. It has much in common with other reptiles, birds and mammals. It controls the physical functioning of the body, quick responses, and the "fight or flight" instinct.

A biological designation for a group of animals that includes humans, monkeys, apes and similar animals that have forward-facing eyes, binocular vision, and opposing thumbs.

The modern mammalian brain is found only in highly functioning mammals like humans and apes. It is where conscious decisions are made.

The primitive mammalian brain has much in common with birds and other mammals, but not reptiles. It is where emotions and hormones are processed and where long-term memory resides.

Triune brain refers to the brain as having three (tri) levels related to how the brain developed over time. The most primitive part of the brain is in the center and the more modern part is on the outside.

The occipital lobe is in the back of the brain and is where vision is controlled.

The parietal lobe is at the top and back of the brain. It helps to perform sensory and language functions.

A section of the brain that is closely associated with visual information and creative processes.

The actual structure of the brain that you can see and touch.



## How We Think and Learn

# Brainstorming<sup>1</sup>

Sometimes it's hard to get started on a project. You just can't think what to do next. One strategy for getting out a lot of ideas quickly is Brainstorming. This helps you and others to create a list of ideas in response to an initial question or idea.

Brainstorming emphasizes:

- broad and creative thinking
- inviting all participants' points of view
- ensuring that all relevant aspects of an issue or question are considered

Here's an example of a question that might benefit from the brainstorming approach: *How should we tell people about our upcoming open house in order that we get good attendance?*

## Brainstorming Steps

Use a flipchart, whiteboard, or blackboard and follow these steps:

1. Introduce your need (ideas) and how brainstorming works:
  - All ideas, however simple or creative, are welcome
  - No one will comment on the ideas during the brainstorm
  - If you wish, offer a one minute "quiet period" before the brainstorm for people to reflect upon or start lists of ideas on their own
  - Explain what will be done with the brainstormed ideas
2. Write the question about which you want ideas at the top of the board or first page of flipchart paper.
3. Start the quiet time for individual writing if you decide to use that.
4. Begin the brainstorm.

<sup>1</sup> Adapted from Massachusetts Institute of Technology, Organization & Employee Development Web site  
<http://web.mit.edu/hr/oed/toolbox/brainstorm.html>

5. Guide the brainstorm by writing ideas as they come, stopping any comments that evaluate ideas and inviting new ideas, and encouraging the group to share their ideas freely. Help generate energy and free-thinking through encouragement.
6. When one flipchart page is full, tear and post it where it is visible, then start the next.
7. As the responses slow down, suggest some ideas that might stimulate further ideas, offer last chances for additional ideas, then stop the brainstorm. Thanks people for participating.
8. Number or letter the ideas when you have the full list.
9. Ask for clarification of any ideas that are not clear to you or others.

### **Tips from Experience**

Brainstorming relies on people thinking and sharing freely. Remind them of this as you enter the activity, and reinforce initial ideas and creative ideas to help everyone participate freely and fully.

Be ready to stop the first effort at judging a suggested idea (as well as subsequent judging types of comments). Remind the group that brainstorming accepts all ideas without criticism or evaluation.

Especially in groups where some individuals may be more reflective thinkers, give people a minute to start jotting down some thoughts on their own before starting the group brainstorm aloud. This will help those people get started with the whole group and generally that will keep them going.

Writing technique: Use two different colored markers, alternating them with each idea. Make your letters 1.5 inches high or more so all can see (and work off of).

With an active group, use two scribes so the writing doesn't slow down the idea generation.

### **Taking Action**

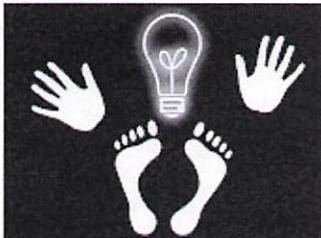
What do you do with your brainstormed list? Here are some of many possible options.

You may want to take the list to review yourself, and act according to what you have and what you have to do.

You may want to process the ideas by asking the group to make comments that build the ideas according to some criterion, i.e. "Let's go down the list and give me a next step for making this idea happen."

You may want to develop a shorter list from the full list by combining related items or prioritizing the items according to some criteria or by group opinion.

One way to prioritize items on a list is to use "sticky dot" voting. Give each participant 1-3 sticky dots and ask them to put a dot next to the items they think most answer the original question. Identify those items that get the most votes and eliminate those items that have the fewest votes. This is not a mechanistic process. Leave time for discussion if someone feels strongly about an item.



## How We Think and Learn

# Introduction to Multiple Intelligences

People are smart in many different ways.

The concept of IQ as a way to define intelligence is so last century. The idea that you can determine a person's intelligence based solely on logical and analytic skills is just wrong.

- So says Dr. Howard Gardner and increasing numbers of educators and psychologists.
- They state that people have "multiple intelligences."
- Understanding what these are and how they work can help people take advantage of their unique skills.

The concept of multiple intelligences has been around since 1983, when Howard Gardner first introduced the idea. It is fairly obvious that people are smart in many ways. However, no one before had worked through a way of describing these smarts the way Gardner did.

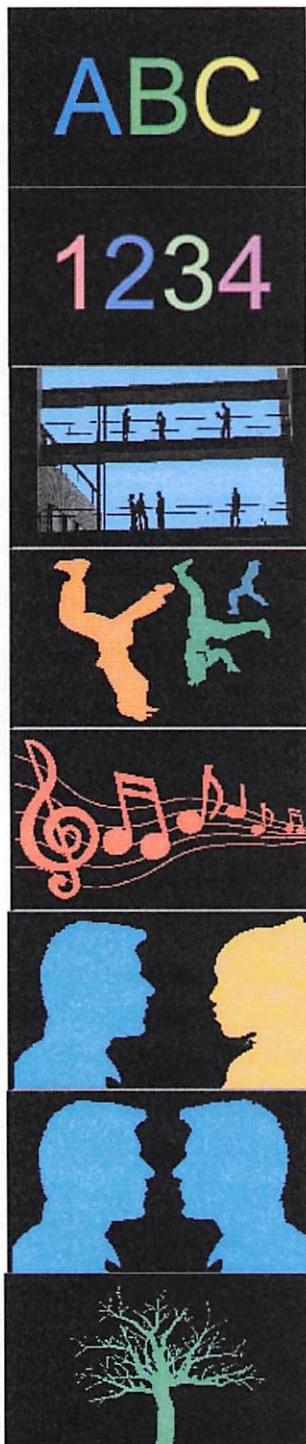
There has been a lot of research in the past decade to see how his ideas might be used to improve teaching and learning. Evidence shows that if teachers and students engage their multiple intelligences, learning on all levels improves.

The Multiple Intelligences model of learning seeks to build on students' strengths in multiple areas to help them become better learners. For students to take advantage of their multiple intelligences, it is important for them understand how they are smart.

Eight types of intelligence have been identified by Gardner and others. More will probably be identified in the future. The following page describes each of these intelligences. Which do you think most apply to you?

# How We Are Smart

# Multiple Intelligences



## 1. Verbal-Linguistic (Word Smart)

Effectively uses words, likes to write and talk

Types of Jobs: Writer, Public Speaker, Storyteller, Salesperson, Editor

## 2. Logical-Mathematical (Number Smart)

Effectively uses numbers, likes to think through a problem

Types of Jobs: Accountant, Mathematician, Check-out Clerk, Computer Programmer

## 3. Spatial (Picture Smart)

Thinks in images and pictures

Types of Jobs: Artist, Architect, Interior Designer, Guide, Cab Driver

## 4. Bodily-Kinaesthetic (Body Smart)

Uses one's body to express ideas and feelings

Types of Jobs: Dancer, Athlete, Craftsperson, Surgeon, Motorcycle Racer

## 5. Musical-Rhythmic (Music Smart)

Enjoys and responds to music, melody, and rhythm

Types of Jobs: Musician, Singer, Composer, Disk Jockey

## 6. Interpersonal (People Smart)

Works well with others, a team player

Types of Jobs: Social Worker, Supervisor, Teacher, Coach, Child Care Worker

## 7. Intrapersonal (Self Smart)

Works well on one's own, self-reflective

Types of Jobs: Therapist, Poet, Philosopher

## 8. Naturalist (Nature Smart)

Enjoys and has a sense about nature

Types of Jobs: Park Ranger, Cook, Landscaper, Gardner



How We Are Smart

# Multiple Intelligences Review

Name \_\_\_\_\_ Date \_\_\_\_\_

Write in the number of the correct multiple intelligence next to the matching job groupings listed below.



1. Verbal-Linguistic (Word Smart)
2. Logical-Mathematical (Number Smart)
3. Spatial (Picture Smart)
4. Bodily-Kinaesthetic (Body Smart)
5. Musical-Rhythmic (Music Smart)
6. Interpersonal (People Smart)
7. Intrapersonal (Self Smart)
8. Naturalist (Nature Smart)

#

- \_\_\_\_\_ Musician, Singer, Composer, Disk Jockey
- \_\_\_\_\_ Dancer, Athlete, Craftsperson, Surgeon, Motorcycle Racer
- \_\_\_\_\_ Accountant, Mathematician, Check-out Clerk, Computer Programmer
- \_\_\_\_\_ Therapist, Poet, Philosopher
- \_\_\_\_\_ Writer, Public Speaker, Storyteller, Salesperson, Editor
- \_\_\_\_\_ Park Ranger, Cook, Landscaper, Gardner
- \_\_\_\_\_ Artist, Architect, Interior Designer, Guide, Cab Driver
- \_\_\_\_\_ Social Worker, Supervisor, Teacher, Coach, Child Care Worker



"We thought that we had the answers, it was the questions we had wrong."

-----  
"My heroes are the ones who survived doing it wrong, but recovered from them."

Bono (1960 – )  
Dublin born musician and social activist; lead singer of rock group U2. He is an activist concerned about social issues such as AIDS, famine, and third world debt.

## How We Think and Learn

# I Think, Therefore I Am

## Latin: Cogito, Ergo Sum"

These words, written by 17<sup>th</sup> century French philosopher, René Descartes, were his example of a statement that could not be doubted. They are our starting point for connecting thinking and learning to who we are and who we can become.

To survive we must be able to think and learn. To thrive we must be able to do these things well. Understanding what impacts our ability to think and learn is one of the most important and valuable things we can do.

From rats to monkeys to humans, all animals must learn to cope with their environments. If they don't, they die. If significant numbers of animals in the same species can't cut it, the species dies out. From the dinosaurs to the Dodo, there are plenty of examples of species that no longer exist. More than any other animal alive today, humans have learned to deal with their environment.



In terms of evolution, in the 21<sup>st</sup> century, humans rule! But surviving isn't enough. It is one thing to live; quite another to live well. One of the biggest influences on how well each of us will live is how we think and learn. Because it is so important, how we think and learn has been the subject of much research.

This document describes some of what a hundred years of research in learning has told us. Another paper looks more at how the brain works and what that means to us. Understanding how we think and learn can help us to become better learners. And this in turn will help us to have better lives.



“My thought is me: that is why I can’t stop. I exist by what I think...and I can’t prevent myself from thinking.”

Jean-Paul Sartre (1905 – 1980)  
French philosopher, playwright,  
and novelist. One of the founders  
of the Existentialist philosophy.

## Learning Occurs Throughout Life

We tend to think learning is what happens primarily when we are in school. In fact, most learning occurs before we come to school and long after we leave school.

Young children must learn to walk, talk, and use their hands to do things. They must learn to use their senses (vision, hearing, smelling, tasting) to understand their environment. And they must learn to interact with others in ways that ensure survival. Once young people leave school, they must learn to function in an adult world of work and responsibility, including raising children of their own.

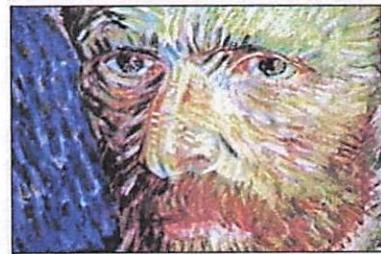
*(Think about some of the things you learned before coming to school. Do you know how you learned them? Did your parent teach you? Did you see someone doing what you learned?)*

## What We Learn Makes Us Who We Are

Each of us is born with a set of characteristics and capacities that make us different from everyone else. However, we had to learn most of what makes us unique. We have no control over what we learn as small children. As we get older, though, we have more and more control over what we learn. Since what we learn determines much of who we are, we have an extraordinary opportunity to define who we are and who we will become.

## You Are Your Own Artist

Think of yourself as a canvas that is partially painted, but much is left undone. Someone else created the first part of the painting, but you are now the artist for the rest. Your own learning is the paint. The more you learn, the more options you have in defining yourself. The more you learn, the more options you have. So understanding how people learn and how it applies to you is very useful for creating yourself.



From a self-portrait by Vincent Van Gogh (1853 – 1890) Dutch painter; suffered from years of depression and mental illness; created some of the most powerful paintings of the 19<sup>th</sup> century.

## Factors That Impact Our Ability to Learn

Scientists have identified four key factors that influence our ability to learn and the speed of learning:

- (1) **Age:** Although young children learn certain things more easily, such as how to speak another language, people continue to learn throughout their lives, unless illness or injury occur. Learning is a life-long pursuit.
- (2) **Motivation:** A person will not learn something unless he or she is interested in it. The more a person knows, the more likely he or she will want to learn more.
- (3) **Prior Experience:** New knowledge builds on old knowledge. The brain connects new information or experience to similar previous experience. Knowledge builds in little steps on what has come before; not leaps and bounds.
- (4) **Intelligence:** There are many types of intelligence. Some people learn better in one way, while others learn better in another. Building on multiple intelligences increases a person's ability to learn.

## We Learn in Different Ways

Research has identified many different ways of learning, including:

**Habits:** One of the simplest forms of learning is based on repeated exposure to something. When something happens often, we just get used to it. There are sights and sounds all around us. At first loud noises (such as traffic noise) or bright lights distract us. But after a while, we learn to ignore them. At first our parents had to tell us to brush our teeth in the morning, now we do it without thinking. It has become a habit.

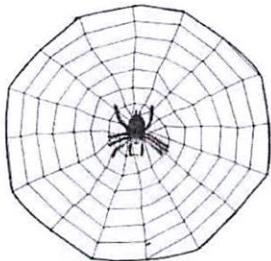
*(Can you think of some things that bothered you at first but you learned over time to ignore?)*

**Classic Conditioning:** In conditioning, a response to one thing can be transferred to something else. Ivan Pavlov conducted a classic experiment in this. He showed food to a dog and noted that the dog salivated before eating the food. At another time when Pavlov rang a bell, it had no effect on the dog. However, after ringing the bell every time he gave the dog food, it would salivate when it heard the bell, even without food being present. This is called a conditioned response. The same thing happens to humans when we think of a lemon. Our brain connects the word "lemon" with our memory of its taste and makes us salivate.

*(Can you think of anything you react to as a result of a conditioned response? This might be a positive or negative feeling or action.)*



An American psychologist named Robert Watson once conducted an infamous study of conditioning with a baby named Albert. Watson showed the baby a white rat. At first the baby was interested in the rat but did not fear it. Then Watson made a loud noise every time he showed the rat to the baby. Soon the baby began to fear the rat since it was connected to the loud and disturbing noise.



People are not born with phobias; they must learn them. A Phobia is an irrational and excessive fear of something such as height, spiders, or flying. Phobias are a form of conditioned response that is generally related to a prior event that caused fear or discomfort. To treat phobias, psychologists often help a person relax and then expose them gradually to whatever it is they are afraid of. The brain then begins to associate the feared object to a positive and relaxed feeling. This also is a conditioned response.

*(Do you have any phobias? If so, can you think of what happened to create the phobia? Can you think of a way you might eventually lose the phobia?)*

Another example of a conditioned response is one treatment for alcoholism. People take a drug that causes nausea after taking a drink. Eventually, for some people, just the sight or smell of alcohol will cause feelings of nausea, even without taking the drug.

**Operant Conditioning:** One of the most widespread uses of conditioning involves offering a reward or punishment for a specific behaviour. The word "operant" refers to the requirement that the learner must operate or take an action as part of the learning. Example: Parents will sometimes reward children for being quiet by saying something nice, smiling at them, or giving them a piece of candy. They might also punish them for being noisy by spanking them. The punishment or reward the child receives is based on his or her behaviour. With this kind of reward and punishment, most children learn quickly to be quiet. They might also learn to fear their parent or to resent authority. Conditioned response is rarely simple and it's hard to fully predict the effect. There are often unintended consequences.

*(Can you think of an example when a parent, teacher or someone else used a reward or punishment to change your behaviour? Was it effective? Were there any unintended consequences?)*

**Observation:** Although conditioning provides one way of learning, much of what we learn is gained through watching others. This is called "observation." This type of learning does not require reward or punishment. It simply requires watching the behaviour of others and then imitating it.

Much of our early personality is formed from observing others, particularly our parents, brothers and sisters. We learn language, habits, social skills, and fears from those closest to us. Later on we often learn athletic, artistic, and academic skills by imitating professional athletes, popular performers, and teachers. As teenagers, we learn much of our behaviour from our peers. When we get a job, we often watch our co-workers to figure out what we are to do.

### The Bobo & Me



Exactly what we learn from observation generally depends on what we believe we need to survive and win approval. In one experiment, a preschool child was asked to work on a drawing while a television set in the room showed an adult beating up on an inflatable Bobo doll.

The adult struck, jumped on, and threw the Bobo around the room, often yelling at it. Later, when the child was left alone in a room filled with toys, including a Bobo, the child repeated the aggressive behaviour he had observed. Further experiments showed that children responded to the Bobo based on what they thought would win them adult approval.

As children grow older, they look to others for approval. They tend less to imitate their parents and look to their friends or sports stars and celebrities for models of behaviour. Young people often try out various models to see how it feels and how others respond.

Research indicates that both children and adults are more likely to imitate someone who is similar to them in age, sex, and background. Whether an imitated behaviour sticks or not generally depends on how others react. When someone of importance to the person reacts positively, the behaviour is "reinforced" and is more likely to be continued.

Often, when several people react differently to a behaviour – such as a parent's or friend's response to a tattoo – the learner values his or her peer's response over the parent's. This is most true for people in their teenage years.

*(Can you think of something you learned from observation that totally upset your parents but your friends approved of? Which person or persons influenced you more?)*

## The Media Also Influences Learning

Our models for imitation do not have to be real and we do not have to see them to learn from them. The movies and television are powerful transmitters of models of behaviour.

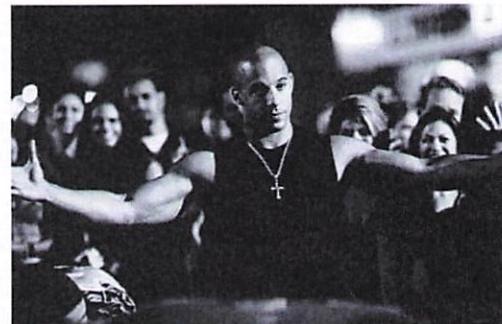
How much movies and television influences our behaviour is heavily debated. Although most children watch thousands of dramatized murders on TV while growing up, it is not clear how much this influences their behaviour. Most psychologists, though, now believe that violence on television and in the movies does lead to increased aggressiveness in children.

Novels and short stories are not as visually compelling as TV or movies, but they also influence our behaviour and our understanding of what is good and bad.

The bravery of Homer's Odysseus has been a model for adventurers for thousands of years. Shakespeare's Romeo and Juliet continue to define star-crossed lovers.



Painting of Tom Sawyer and boys by Norman Rockwell (1894 – 1978)  
Painter and illustrator noted for images of ordinary life.



Vin Diesel plays a tough street racer in The Fast and Furious, both reflecting and promoting this dangerous activity.

J.K. Rowling's Harry Potter and friends Hermione and Ron are models of youthful adventure, just as Mark Twain's Tom Sawyer and Huckleberry Finn were 100 years ago.

Of course we learn many things other than behaviours when we watch television or read a book. This is like learning through observation, except we don't have to be present to learn about it. The media greatly extends our ability to learn about things that we can't directly observe or do.

*(Can you think of anything you do or believe in that relates to something you have read or seen on television or at the movies? This includes the clothes you like, the slang you use, the car you want to drive, or work you want to do.)*



**“The real problem is not whether machines think but whether men do.”**

B.F. Skinner (1904 – 1990)  
Father of the theory of operant conditioning based on stimulus and response; inventor of the “Skinner box” which used food pellets to teach a rat to press a bar to be fed; author of *Walden II*, a utopia-like commune run on the principles of operant conditioning.

## The Rest of the Story

In all the examples above we haven’t mentioned memorizing vocabulary, practicing multiplication tables, studying for a test, or learning how to throw a ball. Of course these also are forms of learning. Our concern here is to broaden the typical definition of learning and to help you see how learning is part of most of what we do. Remember these basic facts:

- Learning goes on throughout our lives.
- A person will not learn unless motivated to do so.
- All learning builds on prior knowledge. The more background knowledge a person has, the easier it is to learn new knowledge.
- People are intelligent in many ways. Using multiple intelligences to explore a subject helps us learn and remember.

Remember also that how we think and what we know defines who we are. We learn all the time when we are children but we have little control over the things that influence our learning. As we grow older, we have more and more control. But what we know and believe is still strongly influenced by our family, friends, culture and the popular media. Sorting through these multiple influences to clarify who we really are and what we actually believe is an ongoing challenge. But understanding how our thinking and learning are influenced can help us to create our own unique and genuine person.

## How We Think and Learn

# Vocabulary

<b>Species</b>	A biological classification for a group of animals or plants that are genetically similar and often resemble each other. Human beings are a species of animals.
<b>Dodo</b>	A large, flightless bird of the pigeon family that became extinct in the late 17 <sup>th</sup> century. An insulting reference to someone regarded as thoughtless or unintelligent.
<b>Evolution</b>	Theory of development of life from earlier forms based on adaptation to survive changing conditions.
<b>Ivan Pavlov</b>	A Russian physiologist who became famous for his studies of conditioned responses in dogs. Won a Nobel prize in 1904.
<b>Salivate</b>	The process of creating saliva in the mouth, especially when food is seen, smelled or expected.
<b>Conditioned response</b>	A learned response that is based on an association with a previous response. Pavlov taught dogs to salivate to the sound of a bell by ringing the bell every time he fed the dogs.
<b>Infamous</b>	The opposite of famous; notorious; having a bad reputation; noted for doing something extremely bad.
<b>Phobia</b>	A strong and irrational fear or dislike of something such as spiders, height, or tight spaces.
<b>Unintended consequence</b>	The result of an action that was not planned or expected.
<b>Observation</b>	Something seen or viewed.
<b>Reinforced</b>	Something that has been strengthened.
<b>Compelling</b>	Something that holds someone's strong attention.
<b>Star-crossed</b>	Destined to be unhappy because of factors beyond control.
<b>Clarify</b>	To make something clearer.

## How We Think and Learn

# Vocabulary Match

Write each of the following words next to its matching definition.

- |                |              |                          |
|----------------|--------------|--------------------------|
| • Species      | • Dodo       | • Evolution              |
| • Ivan Pavlov  | • Salivate   | • Conditioned response   |
| • Infamous     | • Phobia     | • Unintended consequence |
| • Observation  | • Reinforced | • Compelling             |
| • Star-crossed | • Clarify    |                          |

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A large, flightless bird of the pigeon family that became extinct in the late 17<sup>th</sup> century. An insulting reference to someone regarded as thoughtless or unintelligent.

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A biological classification for a group of animals or plants that are genetically similar and often resemble each other. Human beings are a species of animals.

---

Theory of development of life from earlier forms based on adaptation to survive changing conditions.

---

A Russian physiologist who became famous for his studies of conditioned responses in dogs. Won a Nobel prize in 1904.

---

The process of creating saliva in the mouth, especially when food is seen, smelled or expected.

---

A learned response that is based on an association with a previous response. Pavlov taught dogs to salivate to the sound of a bell by ringing the bell every time he fed the dogs.

---

The opposite of famous; notorious; having a bad reputation; noted for doing something extremely bad.

---

Something that holds someone's strong attention.

---

A strong and irrational fear or dislike of something such as spiders, height, or tight spaces.

---

The result of an action that was not planned or expected.

---

To make something clearer.

---

Something that has been strengthened.

---

Something seen or viewed.

---

Destined to be unhappy because of factors beyond control.

## How We Think and Learn

# Let's Think About It

Name \_\_\_\_\_ Date \_\_\_\_\_

1. The paper starts with a quote from Descartes, "I think, therefore I am." What do you think he meant by this statement? Can you think of another proof of your own existence?

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2. You were asked to think about various things while reading the paper. Answer these questions below. Remember, there are no right or wrong answers, but you are expected to be thoughtful in your responses.
  - a. Think about some of the things you learned before coming to school. Do you know how you learned them? Did your parent teach you? Did you see someone doing what you learned?

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- b. Can you think of some things that bothered you at first but you learned over time to ignore them?

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- c. Can you think of anything you react to as a result of a conditioned response? This might be a positive or negative feeling or action.

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- d. Do you have any phobias? If so, can you think of what happened to create the phobia? Can you think of a way you might eventually lose the phobia?

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- e. Can you think of an example when a parent, teacher or someone else used a reward or punishment to change your behaviour? Was it effective? Were there any unintended consequences?

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- f. Can you think of something you learned from observation that totally upset your parents but your friends approved of? Which person or persons influenced you more?

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- g. Can you think of anything you do or believe in that relates to something you have read or seen on television or at the movies? This includes the clothes you like, the slang you use, the car you want to drive, or work you want to do.

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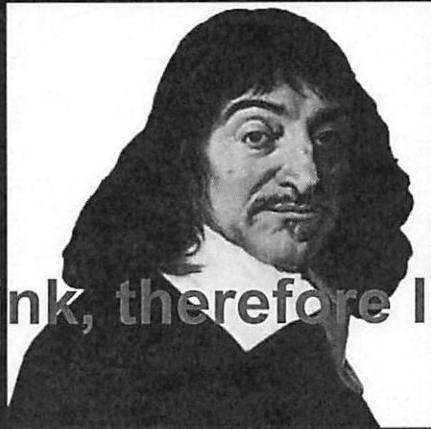
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3. Bonus Question: On the front page, singer Bono is quoted as saying, "We thought that we had the answers, it was the questions we had wrong." What do you think he means by this?

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**“I think, therefore I am.”**

René Descartes



**“We thought that we had the answers, it was the questions we had wrong.”**

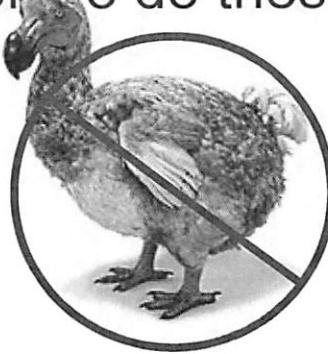
Bono



“My thought is  
me: that is why  
I can’t stop. I  
exist by what I  
think...and I  
can’t prevent  
myself from  
thinking.”

Jean-Paul Sartre

To survive, we must be able to think and learn. To thrive, we must be able to do these things well.



**NO DODOS!**

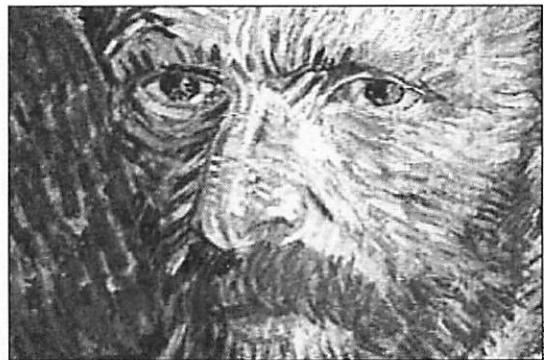
**Learning occurs throughout life – long before and after we attend school.**

- Young children must learn to walk, talk, and use their hands.
- They must learn to use their senses: vision, smell, hearing, taste, touch.
- Older kids must learn to get along with others and build basic skills.
- Adults must learn to work together and accept responsibility.

**What we learn makes us who we are.**

- Each of us is born with inherited characteristics and capacities.
- However, we need to learn most of the things that make us unique individuals.
- Knowing how we think and learn helps us take control over defining who we are and who we will be.

You are your own artist. In a real sense, what you learn defines who you are. Learning is your pallet.



## Factors That Impact Our Ability to Learn

- Age: Children can learn some things more readily, but learning occurs throughout our lives.
- Motivation: A person must be motivated to learn for learning to occur.
- Prior Experience: New knowledge builds on old. The more prior knowledge, the easier it is to learn.
- Intelligence: There are many types of intelligence. Building on multiple intelligences increases a person's ability to learn.

We learn in different ways. One way is through habits.

- A common and simple form of learning is through the development of habits.
- Habits result from repeated behaviours and do not have to be thought about.
- Some habits help us block out unwanted distractions like traffic noise.
- After a while we just don't notice.

*Can you think of some things that you learned and are now a habit?*

We also learn through conditioning.

- A conditioned response is one that links one reaction to another.
- A classic example is when Pavlov caused a dog to salivate at the sound of a bell by ringing the bell every time he fed the dog.
- When we salivate when we think of a lemon, this is also a form of a conditioned response.

*Can you think of anything you react to as a result of a conditioned response?*

*Do you have any phobias? What happened to create the phobia? Do you think you might lose the phobia?*

Another form of conditioning is called “operant conditioning.”

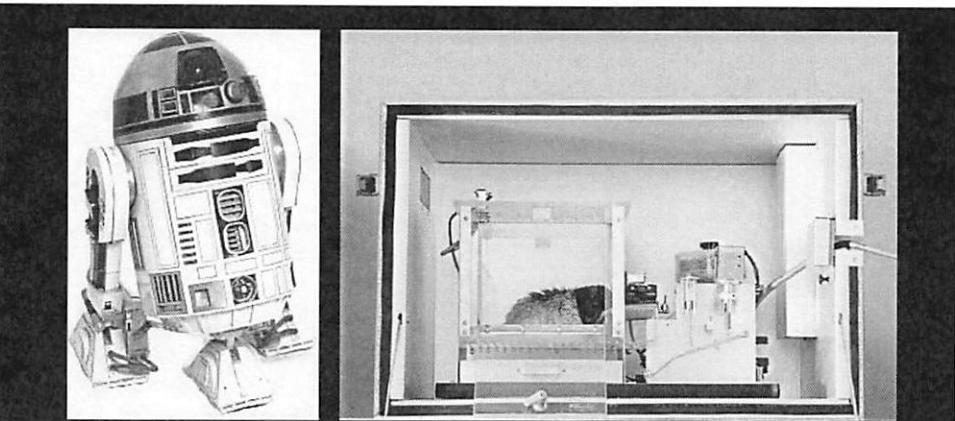
- This form of conditioning involves providing a reward or punishment for a desired behaviour.
- This is called positive or negative reinforcement.
- Operant conditioning may result in “unintended consequences.”

*Can you think of an example when a parent, teacher or someone else used a reward or punishment to change your behaviour? Was it effective? Were there any unintended consequences?*

**Observation is one way that everyone learns throughout life.**

- We learn most of our social behaviour by watching others.
- At first we learn from our parents, brothers and sisters.
- Later on we learn most from our peers.
- We also learn by watching television, movies and reading books.

*Can you think of something you learned from observation that totally upset your parents but your friends approved of? Which person or persons influenced you more?*



**“The real problem is not whether  
machines think but whether men do.”**

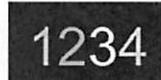
B.F. Skinner

## Multiple Intelligences

Model developed by Howard Gardner, Harvard University



Verbal-Linguistic



Logical-Mathematical



Spatial



Bodily-Kinesthetic



Musical



Interpersonal



Intrapersonal



Naturalist

## Verbal-Linguistic

Effectively uses words, likes to write and talk

Types of Jobs:

- Writer
- Public speaker
- Storyteller
- Salesperson
- Editor



## **Logical-Mathematical**

Effectively uses numbers, likes to think through a problem

Types of Jobs:

- Accountant
- Mathematician
- Check-out clerk
- Computer programmer



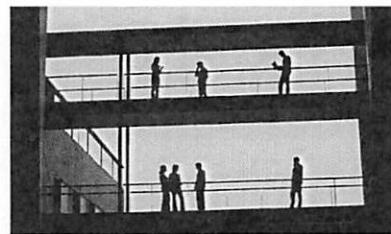
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## **Spatial**

Thinks in images and pictures

Types of Jobs:

- Guide
- Interior decorator
- Architect
- Artist
- Cab driver



## **Bodily-Kinesthetic**

Uses one's body to express ideas and feelings

Types of Jobs:

- Dancer
- Athlete
- Craftsperson
- Mechanic
- Surgeon



## **Musical**

Enjoys and responds to music, melody, and rhythm

Types of Jobs:

- Musician
- Singer
- Songwriter
- Disk jockey

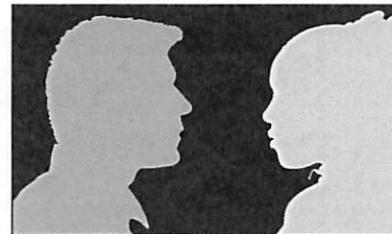


## **Interpersonal**

Works well with others, a team player

Types of Jobs:

- Social worker
- Supervisor
- Health care worker
- Teacher
- coach

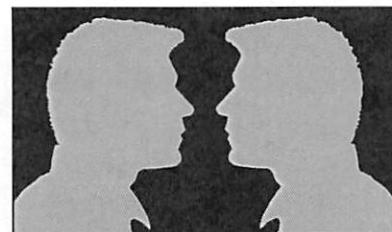


## **Intrapersonal**

Works well on one's own, self-reflective

Types of Jobs:

- Novelist
- Editorial writer
- Poet
- Philosopher

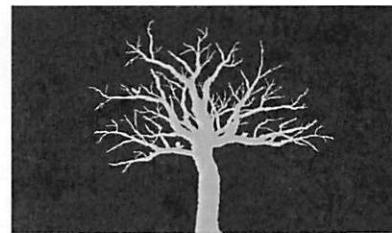


## Naturalist

Enjoys and has a sense about nature

Types of Jobs:

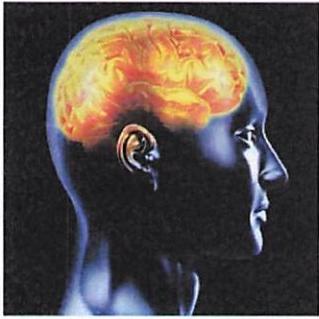
- Park ranger
- Cook
- Landscaper
- Gardener



## Howard Gardner (1943-)



Professor of Education, Harvard University - In *The Unschooled Mind: How Children Think and How Schools Should Teach*, he discusses "different learning styles and calls for doing away with our 'fast food-food approach to education' to accommodate all children, not just those who find it easy to learn in traditional ways."



## How We Think and Learn

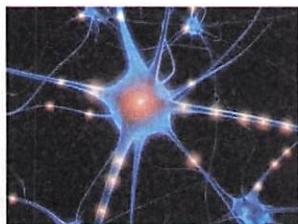
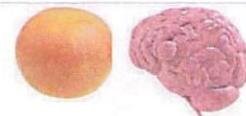
# My Brain and I

Humans are not unique. All animals have brains. The human brain isn't even the biggest brain. That honour belongs to the blue whale. However, humans have the largest brains relative to our size. Still, size isn't all that matters. Einstein's brain was smaller than average and he was one of the most intelligent persons ever to live.

So what is the brain, exactly? Are you stuck with the brain you've got? Is there anything you can do to make your brain better?

## What is the Brain?

The brain is a soft piece of flesh about the size of a large grapefruit, weighing about three pounds in adults. It controls nearly everything we think and do. It controls a lot of things we have no control over, such as breathing, heart rate, and sweating. It lets us do things we do have some control over, such as throwing a ball, talking, and sitting in a chair. It accepts information from our senses (seeing, hearing, touching, smelling, tasting) and interprets the data so we know what's going on. It holds our memories, lets us dream, think, and feel emotions.



100-billion nerve cells exchange information constantly with other nerves along a neural network.

Our brain has approximately 100-billion nerve cells called neurons. These neurons are the database for everything we know and can do. Small nerve endings branch out from the nerve and connect with other nerves. This "neural network" is how the nerves communicate with each other. These cells provide information that allows us to maintain our balance, duck a dodge ball, write a poem, and many other useful things.

Different parts of the brain control special functions such as seeing and speaking, remembering and decision making. Some sections of the brain operate automatically, such as the section that controls our heart beat and breathing. Other parts of our brain store memories, feelings and facts. We can easily access this information. A specialized section of the brain helps us recognize

faces, cars and other objects such as birds. Our brain also holds similar information that is not so easily accessed. This is often called our "unconscious mind." Your dreams and feelings that you don't understand often come from the unconscious mind. Even though we may not be aware of it, this part of the mind can have a strong impact on what we think and do.

### **Am I Stuck with the Brain I've Got?**

Not exactly. The brain is pre-wired to some extent at birth. But the brain continues to develop throughout life. New neurons are continually being created and connecting to other neurons. These connections determine what we think. As the connections change, what we think also changes. Our ability to accept and use new information is based on how the brain has organized information from previous experiences. The brain retains information only when it can connect neurons to prior knowledge.

### **Is There Anything I Can Do to Make My Brain Better?**

Yes, absolutely! Just like eating right and exercising helps build muscles, exercising your brain improves thinking skills. Thinking happens naturally, but research indicates that there are ways to help your brain think better. Here are some basic strategies:

- **Take Care of Your Body:** Your body and mind are closely linked. Smoking, alcohol and drug abuse often slow down the brain and can do permanent damage to neurons. Failure to get enough sleep can also modify brain activity. Sleep deprivation, for example, is a common technique for breaking the will of prisoners.
- **Increase Your Background Knowledge:** New information builds on old information. For information to make sense, it must connect with something you already know. Put simply, this can be expressed as, "The more you know, the more you can know." For instance, if you don't speak Chinese, your brain will retain nothing of what someone says who is talking to you in Chinese. If you know nothing about or do not care about motorcycles, you'll remember little from someone describing her new Kawasaki dirt bike. Likewise, a news article about starvation in Darfur will mean little to someone who doesn't know the country is in Africa. Try to learn something new every day. Open yourself to new avenues for learning. If you don't read, talk to the same people every day, and watch the same TV shows, you are not opening yourself to many new learning opportunities. Try breaking old habits, read

books and magazine articles about new topics, and try new activities that challenge your thinking. This will help you learn even more without having to think about it.

- **Expand Your Vocabulary:** Our vocabulary consists of the words we understand and can use. Our vocabulary helps us understand what we read and others say. It allows us to form and express ideas. Vocabulary is stored in the brain's neurons. As with other knowledge, the larger a person's vocabulary, the more likely new information will stick in the brain. A good strategy for increasing your vocabulary is to not just pass over a word you don't know. If someone says a word you don't know the definition of, ask what the person means. If you see a word in a book you don't know, stop and look it up. If you like the word, write it down and try using yourself several times.
- **Consciously, Try to Relate New Learning to What You Already Know:** Our senses are bombarded daily with far more information than we can take in. So, rather than allowing us to be overwhelmed, our brain filters out much of what we see, feel and hear. It prioritizes information it feels is most important based on what is already stored in the brain. Things that deal with safety and strong emotions are given top priority. A homework assignment, however, may be given low priority if you don't think it's very important. One strategy for remembering things better is to attach the new information to a strong feeling you already have. If you truly want to remember something, pause for a minute and think about how something you want to remember relates to something you already know.
- **Use a Mnemonic (pronounced newmonik) to Remember Lists:** A mnemonic is a memory aid that helps you remember things, generally lists of things. A common strategy is to create an easy to remember word or phrase that includes the first letters of things you are trying to remember. For instance, the name Roy G. Biv can help you remember the colors in a rainbow: red, orange, yellow, green, indigo, and violet. Here's another one used to remember the order of taxonomy in biology: King Philip cuts open five green snakes: Kingdom, Phylum, Class, Order, Family, Genus, Species.

### Remember

Our brains continue to develop throughout our lives. How well they develop is strongly influenced by what we do. Making good choices to improve your brain's knowledge and ability to function is one of the best things you can do for yourself – and it doesn't cost anything.

# My Brain and I

## Vocabulary

<b>Albert Einstein</b>	(1879-1955) German-born American physicist and Nobel Prize winner - the best known scientist of the twentieth century. He realized that matter can be turned into energy and energy can be turned into matter. His formula E=MC <sup>2</sup> lets us calculate how much energy a given amount of mass can create.
<b>interpret</b>	To find or describe the meaning of something.
<b>neuron</b>	A nerve cell that transmits and receives nerve pulses in the brain.
<b>neural network</b>	A system of interconnected neurons in the brain that makes the brain function.
<b>unconscious mind</b>	The part of the brain that stores memories, thoughts, feelings, and ideas that a person is not generally aware of.
<b>pre-wired</b>	A natural ability that is built into the neural network of the brain that allows animals to do things automatically.
<b>deprivation</b>	Preventing someone from having something, such as sleep.
<b>Darfur</b>	A region of the nation of Sudan in north-central Africa. Armed civil conflict has caused the death of many thousands of civilians because of war and starvation.
<b>vocabulary</b>	The words a person knows and can use.
<b>bombarded</b>	Being overwhelmed by missiles or some other form of attack.
<b>prioritize</b>	To rank something according to importance.
<b>mnemonic</b>	A short rhyme, phrase, or other mental technique to help memorize items in a list.
<b>taxonomy</b>	A scientific classification of plants, animals, and organisms.

## How We Think and Learn

# Vocabulary Match

Write each of the following words next to its matching definition.

- |                       |               |                   |
|-----------------------|---------------|-------------------|
| • neural network      | • pre-wired   | • Albert Einstein |
| • interpret           | • neuron      | • mnemonic        |
| • deprivation         | • deprivation | • Darfur          |
| • taxonomy            | • bombarded   | • vocabulary      |
| • unconscious<br>mind |               |                   |

---

(1879-1955) German-born American physicist and Nobel Prize winner - the best known scientist of the twentieth century. He realized that matter can be turned into energy and energy can be turned into matter. His formula  $E=MC^2$  lets us calculate how much energy a given amount of mass can create.

---

To find or describe the meaning of something.

---

A nerve cell that transmits and receives nerve pulses in the brain.

---

A system of interconnected neurons in the brain that makes the brain function.

---

The part of the brain that stores memories, thoughts, feelings, and ideas that a person is not generally aware of.

---

A natural ability that is built into the neural network of the brain that allows animals to do things automatically.

---

Preventing someone from having something, such as sleep.

---

A region of the nation of Sudan in north-central Africa. Armed civil conflict has caused the death of many thousands of civilians because of war and starvation.

---

The words a person knows and can use.

---

Being overwhelmed by missiles or some other form of attack.

---

To rank something according to importance.

---

A short rhyme, phrase, or other mental technique to help memorize items in a list.

---

A scientific classification of plants, animals, and organisms.

---



## My Brain and I

### What is the brain?

- The brain is a soft piece of flesh about the size of a large grapefruit, weighing about three pounds in adults.
- It controls nearly everything we think and do.



## What is the brain?

- The brain controls a lot of things we do not have control over, such as breathing, heart rate, and sweating.



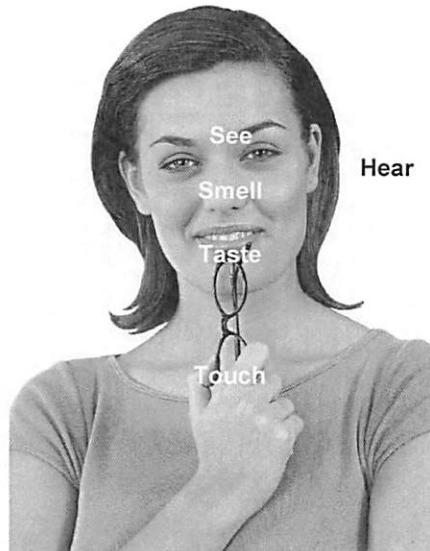
## What is the brain?



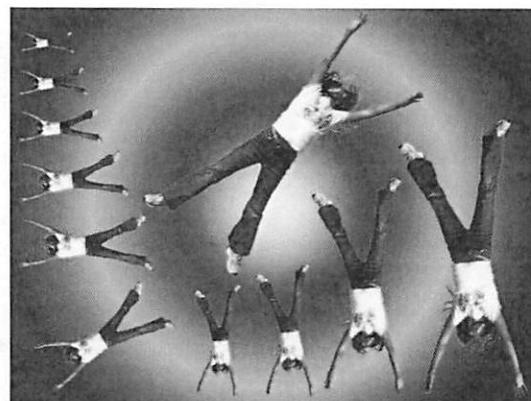
- The brain also controls a lot of things we do have control of, such as throwing a ball, talking, and sitting in a chair.

## What is the brain?

- It accepts information from our senses (seeing, hearing, touching, smelling, tasting) and interprets that data so we know what's going on.

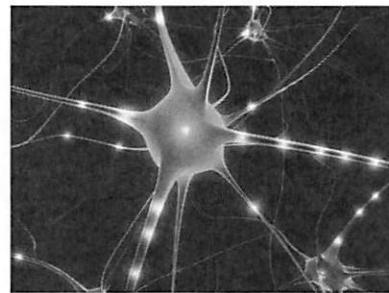


## What is the brain?



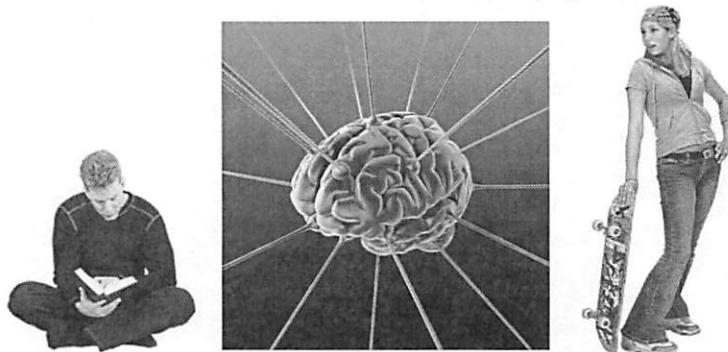
- It holds our memories, lets us dream, think, and feel emotions.

## How does this happen?



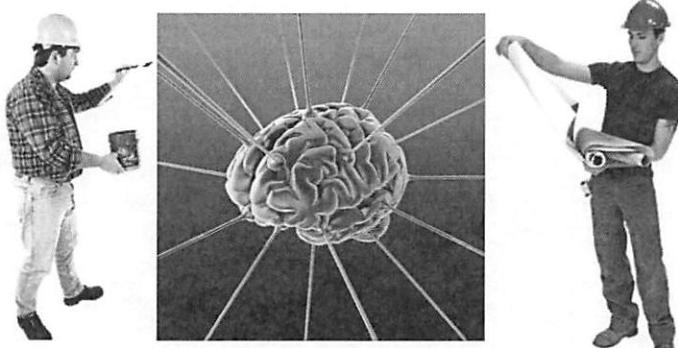
- 100-billion nerve cells hold data.  
They exchange information  
constantly with other nerves along  
a neural network.

## How does this happen?



- New information is added each day based upon what we think and do.

## Can we improve our brains?



- Absolutely! Research indicates there are a number of ways to help our brain think better.

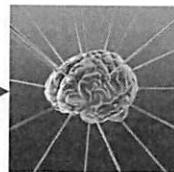
## Take care of your body.



- Smoking, alcohol and drug abuse can do permanent damage to the neurons in your brain.

## Increase your background knowledge.

"My new motorcycle has a 150cc engine. It's a screamer."



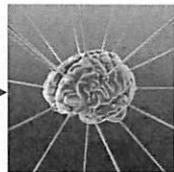
Actually, 150cc is not a very big motorcycle engine. This guy is exaggerating.

- New information must connect with old information. The more you know, the more you can know.

## Expand your vocabulary.

"He has all the virtues I dislike and none of the vices I admire."

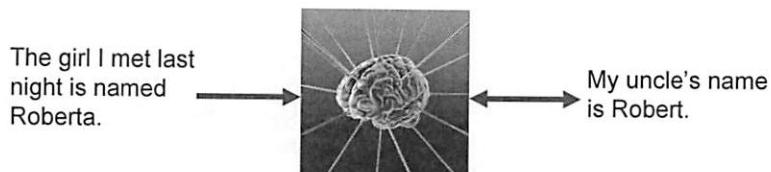
Sir Winston Churchill



Virtue: doing what is right  
Vice: doing what is wrong

- Vocabulary is stored in the brain. The bigger your vocabulary, the more new information is likely to stick.

Try to relate new information to what you already know.



- Our brain filters out most information. If you want to remember something, pause and try to connect it to something you already know.

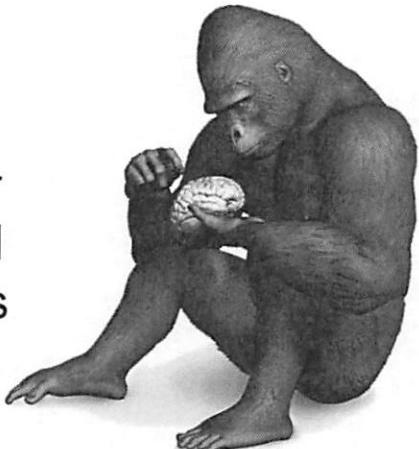
Use a Mnemonic to Remember Lists.

## MNEMONIC

- A Mnemonic is a group of letters, words or phrase that helps us remember lists of things. For instance, "My Dear Aunt Sally" helps us remember that we must multiply and divide before adding and subtracting.

## Remember

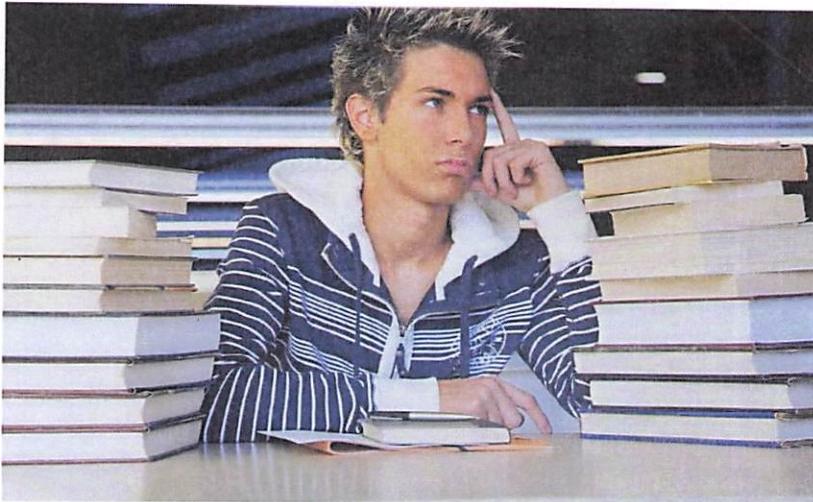
- Our brains continue to develop throughout our lives. How well they develop is strongly influenced by what we do.





How We Think and Learn

## Ways to Remember



Our minds are able to understand what we read even when some of the words are missing. As long as the text we read is logical, the brain will fill in the blanks.

### Let's see how this works.

Look at the paragraphs on the next page and read each sentence carefully. Then fill in the missing words so the sentences and paragraphs make sense. Think about why you put in a certain word or if other words would also fit.

Then compare your answers with those of a partner. Discuss your decision to select a certain word over another. Change your answer if another word makes more sense. Sometimes more than one answer is possible. Choose the word that sounds best given the meaning of the passage.

# Ways to Remember<sup>1</sup>

Some people try to remember things just by \_\_\_\_\_ them over and over, like this: comb, book, can of beans, left shoe, and so on. If you tried that, you were using what scientists call your “working \_\_\_\_\_”.

When you look up a telephone number and repeat it over and over until you \_\_\_\_\_ it, you’re using your working memory. Your working memory is great for jobs like remembering a \_\_\_\_\_ number for a few minutes.

But five minutes later, after you made a phone call using this method, you probably won’t be able to \_\_\_\_\_ the number. Your working memory can hold a small amount of information for a relatively \_\_\_\_\_ time. Repeating a list of things over and over lets you remember some of the \_\_\_\_\_ on the list for a little while. But it’s \_\_\_\_\_ to store twenty different things in your working memory and remember them long \_\_\_\_\_ to write them down.

One way to remember more things for a \_\_\_\_\_ time is to use what scientists call “elaborative encoding.” “Encoding” is another word for \_\_\_\_\_ something into a memory. “Elaborative encoding” lets you connect \_\_\_\_\_ information to memories that you already have, and that helps you remember the new information. It can help you move that list of objects out of your working memory and into your \_\_\_\_\_ memory. (Long-term memory is just what it sounds like: memories that last for a long time – days or \_\_\_\_\_ or years.)

## Note

There are 14 blanks to fill in.

How many of your answers are you sure about? \_\_\_\_\_

Go back and think once more about the answers you are not sure about. Read the next couple of sentences to see if you have the right word or if another word makes more sense.

## Scoring

How many did you get right by yourself? \_\_\_\_\_

How many did you get right with a partner? \_\_\_\_\_

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<sup>1</sup> Adapted from Ways to Remember  
[http://www.exploratorium.edu/memory/dont\\_forget/playing\\_games\\_2.html](http://www.exploratorium.edu/memory/dont_forget/playing_games_2.html)

## Answer Key

# Ways to Remember

Some people try to remember them just by repeating them over and over, like this: comb, book, can of beans, left shoe, and so on. If you tried that, you were using what scientists call your "working memory".

When you look up a telephone number and repeat it over and over until you dial it, you're using your working memory. Your working memory is great for jobs like remembering a phone number for a few minutes.

But five minutes later, after you made a phone call using this method, you probably won't be able to remember the number. Your working memory can hold a small amount of information for a relatively short time. Repeating a list of things over and over lets you remember some of the items on the list for a little while. But it's tough to store twenty different things in your working memory and remember them long enough to write them down.

One way to remember more things for a longer time is to use what scientists call "*elaborative encoding*." "Encoding" is another word for transforming something into a memory. "Elaborative encoding" lets you connect new information to memories that you already have, and that helps you remember the new information. It can help you move that list of objects out of your working memory and into your long-term memory. (Long-term memory is just what it sounds like: memories that last for a long time -- days or months or years.)